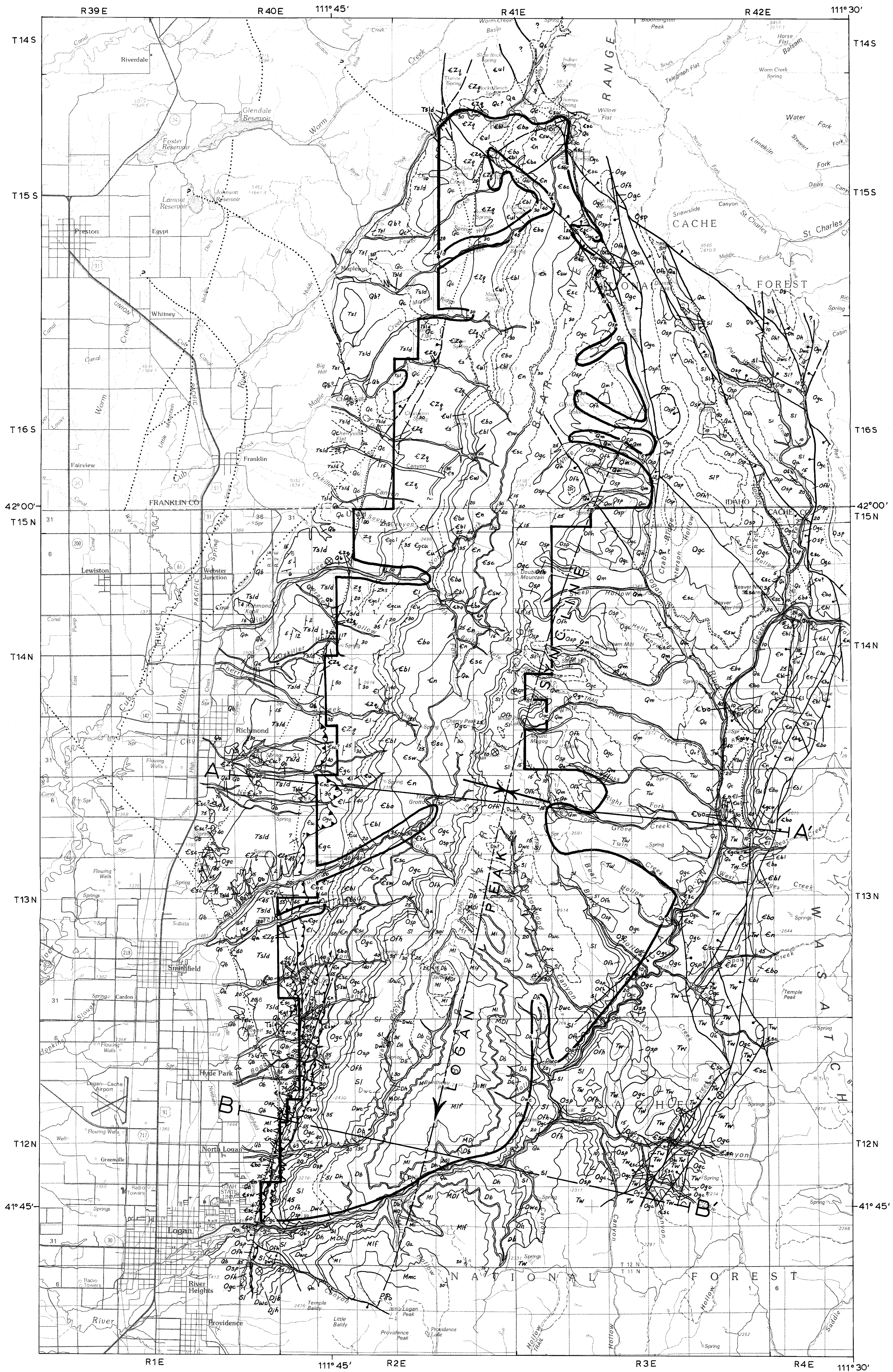
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1566-B



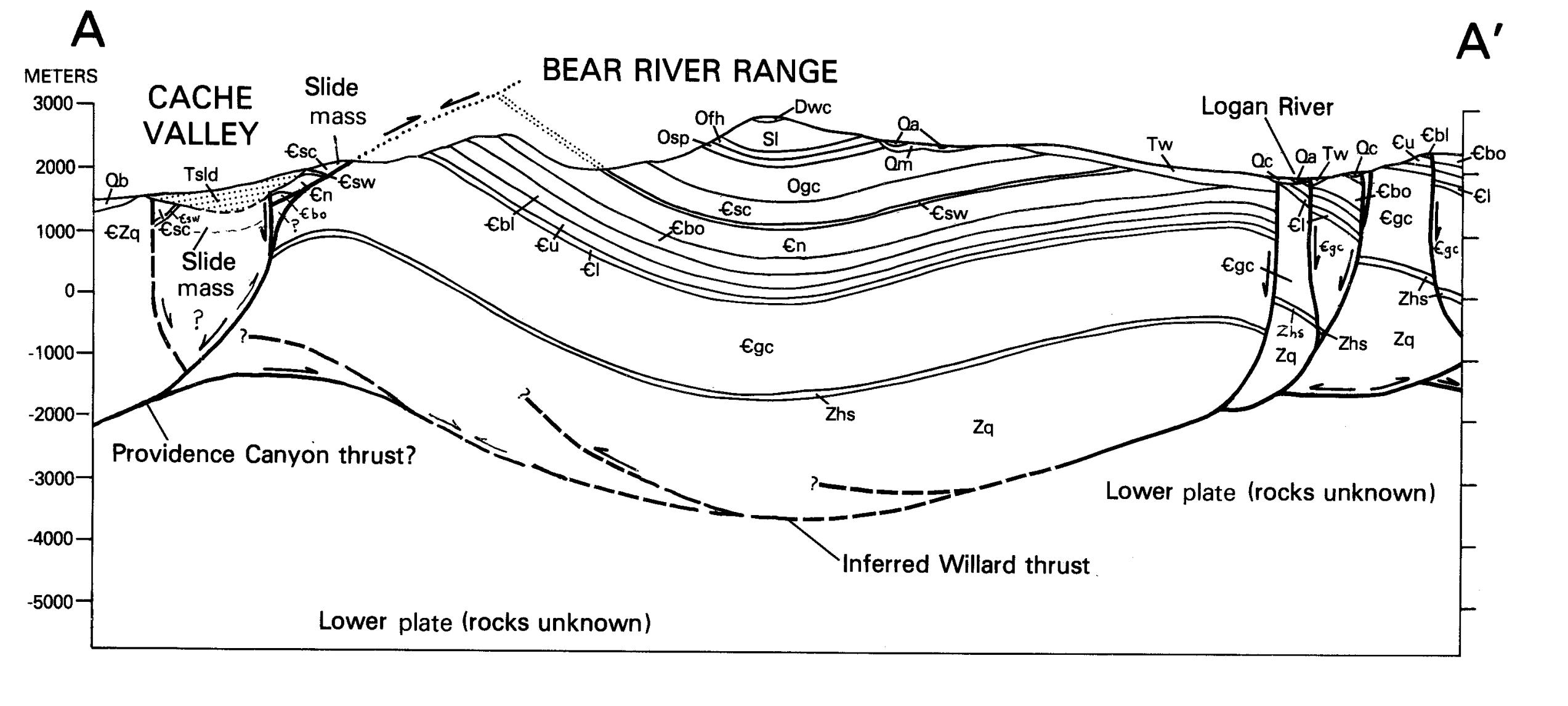
Base from U.S. Geological Survey
Logan, 1976, and Preston, 1975

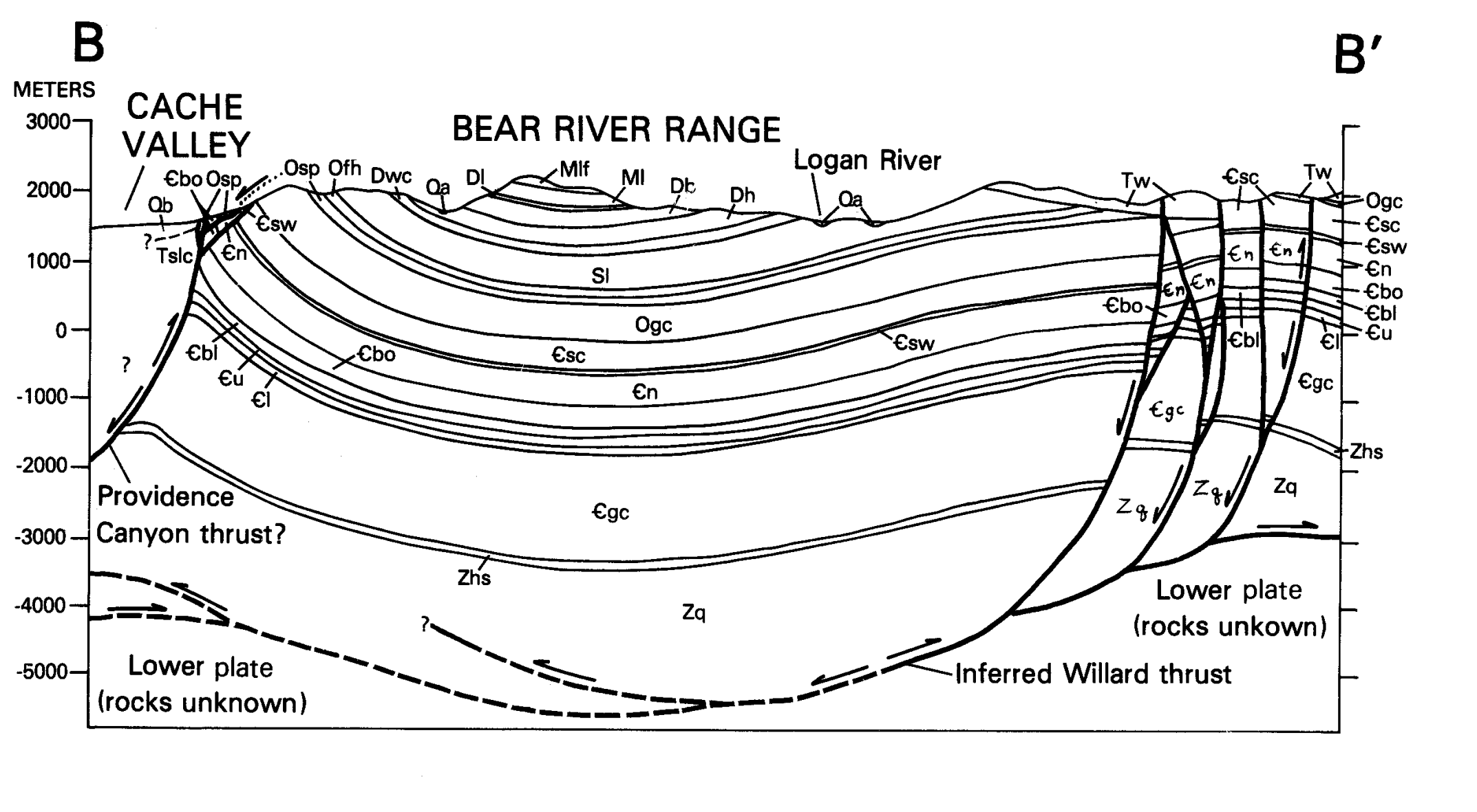
Geologic mapping by J. H. Dover, 1979-80; geology along west edge of roadless area in part compiled or modified from Galloway (1970), Mendenhall (1975), and Oriel and Platt (1968)

SCALE 1:100 000

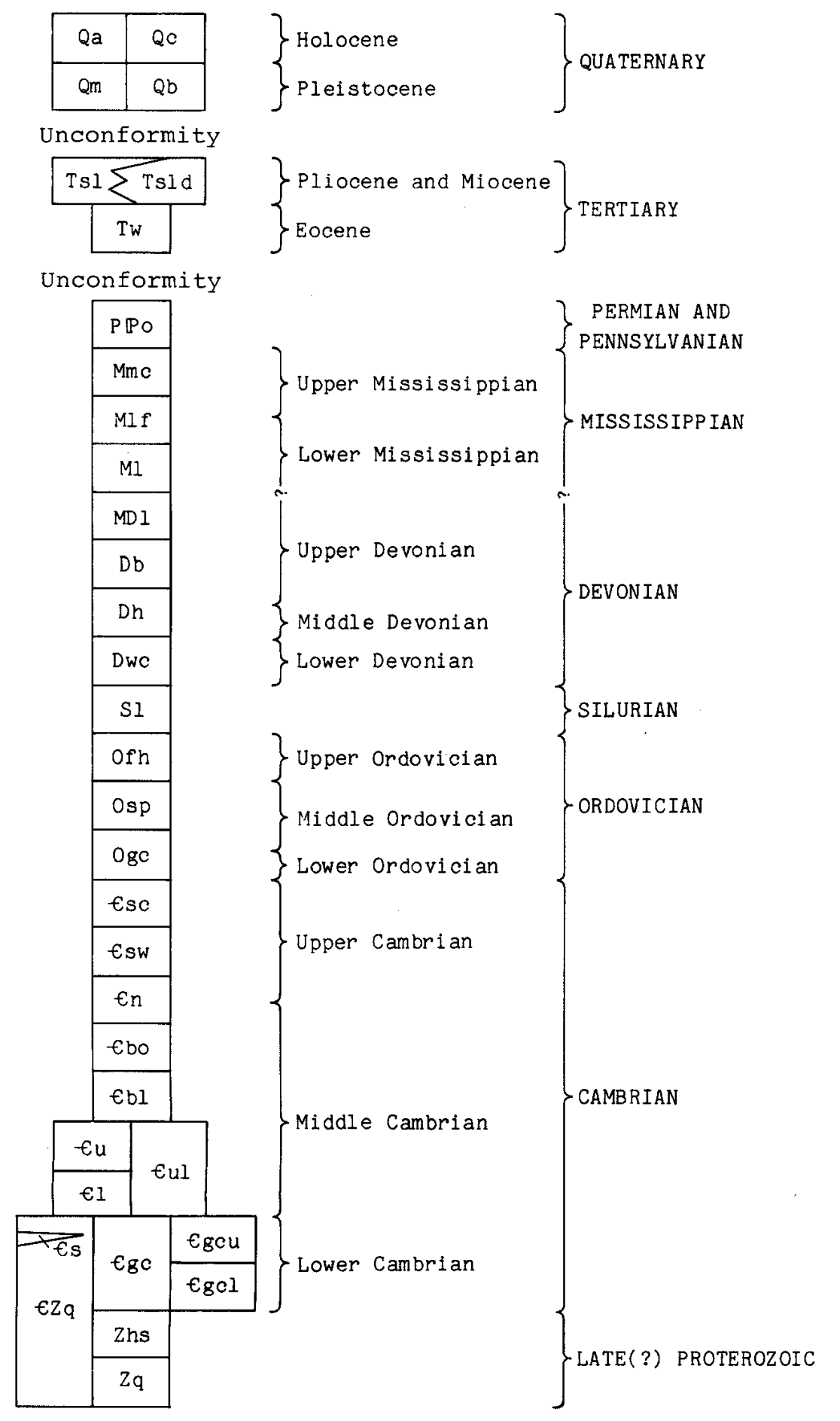
1 ½ 0 1 2 3 4 5 MILES
1.5 0 1 2 3 4 5 KILOMETERS

NATIONAL GEODETIC VERTICAL DATUM OF 1929





CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qa	ALLUVIUM (HOLOCENE)--Unconsolidated, crudely stratified silt, sand, and gravel deposited by streams mainly as channel-fill or flood-plain deposits; locally includes materials deposited in small bogs, lakes, deltas, and alluvial fans
Qc	COLLUVIUM (HOLOCENE)--Locally derived colluvial deposits of unconsolidated, angular, poorly sorted rock debris; occurs mainly as thin veneer or in talus cones along valley sides. Locally includes alluvial-fan deposits and landslide material along fault-line scarps
Qm	MORAINE (PLEISTOCENE)--Poorly sorted and consolidated bouldery till. Mapped only in upper Logan River area; occurs in linear ridges with hummocky topography along tributary streams draining east-facing cirques
Qb	BONNEVILLE FORMATION (PLEISTOCENE)--Poorly consolidated silt, sand, and gravel deposited in and marginal to Lake Bonneville; includes lake-bottom sediments, terraced beach deposits, longshore-bar and spit deposits, deltaic sediments, and alluvial and colluvial deposits graded to various stands of Lake Bonneville
Tsl	SALT LAKE FORMATION (PLIOCENE AND MIOCENE)--White and gray, poorly indurated siltstone, sandstone, and grit; typically tuffaceous and calcareous. Some interbeds reddish near basin margins or greenish where altered. Locally contains white volcanic ash interbeds; one ash bed near south end of Cache Valley yielded fission-track age on zircon of 7.9 Ma (G. A. Izett and C. W. Naeser, written commun., 1981). Mapped only in northwestern part of map area
Tsld	Diamictite--Generally gray, locally buff or pale-reddish-gray, semiconsolidated, crudely stratified, poorly sorted clastic debris representing basin-margin facies of Salt Lake Formation. Angular cobbles, boulders, and blocks as much as 5 ft across of Proterozoic and Paleozoic formations derived from adjacent Bear River Range set in matrix of poorly sorted tuffaceous sandstone and grit. Found mainly in western part of map area; may in part be younger than main body of Salt Lake Formation
Tw	WASATCH FORMATION (LOWER EOCENE)--Reddish- to orange-brown, interlensing siltstone, sandstone, grit, and conglomerate, locally with gray to tan, pebbly pisolitic limestone and marl at the base. Clasts as large as cobble size. Occurs mainly in southeastern part of map area, where generally less than 500 ft is exposed; may be thicker in subsurface
Pℙo	OQUIRRH FORMATION (LOWER PERMIAN AND PENNSYLVANIAN)--Dominantly gray, buff-weathering calcareous sandstone and sandy limestone or dolomitic limestone. Contains subordinate interbeds of quartzite, limestone, and minor interbeds of calcareous shale. Occurs at south-central edge of map area, just outside roadless area boundary; minimum estimated thickness 1,000 ft
Mmc	MONROE CANYON LIMESTONE (UPPER MISSISSIPPIAN)--Comprises upper member of more resistant, medium-bedded, richly fossiliferous cherty limestone; middle member of medium-bedded, slope-forming limestone having numerous bioclastic limestone interbeds; and lower member of massive-bedded, cliff-forming limestone having abundant large horn corals; members not mapped separately. Contains abundant fossils, including corals, brachiopods, bryozoans, crinoids, gastropods, and conodonts; calculated thickness 1,200 ft
Mlf	LITTLE FLAT FORMATION (UPPER AND LOWER MISSISSIPPIAN)--Mainly gray to buff, interbedded, sandy cherty limestone and dolomitic limestone; platy, pinkish-gray-weathering calcareous siltstone; and quartz sandstone; thin basal unit contains phosphatic siltstone having micritic limestone interbeds. Fossiliferous; calculated thickness about 1,300 ft
Ml	LODGEPOLE LIMESTONE (LOWER MISSISSIPPIAN)--Gray, thin- to medium-bedded limestone, bioclastic limestone, and cherty limestone; massive cliff-forming beds at the base and top; richly fossiliferous. Calculated thickness 750 ft
MDl	LEATHAM FORMATION (LOWER MISSISSIPPIAN? AND UPPER DEVONIAN)--Interbedded limestone, sandstone, silty limestone, carbonaceous siltstone and mudstone, and minor chert. Estimated thickness 100 ft
Db	BEIRDNEAU FORMATION (UPPER DEVONIAN)--Buff-weathering, interbedded, silty and sandy, medium-bedded dolomite; fine- to medium-grained quartz sandstone; shaly siltstone; and limestone; top marked by prominent cliff-forming limestone bed 30 ft thick (the "contact ledge" of Williams, 1948). Characterized by intraformational conglomerate, mud cracks, ripple marks, salt casts, and convolute structure. Estimated thickness 1,000 ft
Dh	HYRUM DOLOMITE (UPPER AND MIDDLE DEVONIAN)--Predominantly dark-gray, thick- to massive-bedded, fine-grained dolomite; contains subordinate silty limestone and dolomitic sandstone interbeds. Fresh surfaces have distinctly petroliferous odor. Estimated thickness 850 ft
Dwc	WATER CANYON FORMATION (LOWER DEVONIAN)--White- to light-gray-weathering, thin- to medium-bedded, laminated silty dolomite, sandstone, dolomitic sandstone, limestone, shale, and intraformational breccia; limestone and shale interbeds increase in abundance upward. Contains fossil fish and sparse plant and invertebrate remains. Estimated thickness 425-600 ft
Sl	LAKETOWN DOLOMITE (SILURIAN)--Predominantly light-gray, massive-bedded, medium-grained dolomite; typically has pitted surfaces and "elephant skin" weathering; middle part medium-gray. Forms rugged, steep topography and prominent cliffs. Estimated thickness 1,500-2,000 ft
Ofh	FISH HAVEN DOLOMITE (UPPER ORDOVICIAN)--Dark-gray, massive- to thick-bedded, medium-grained, cliff-forming dolomite having coral and crinoid remains throughout. Estimated thickness 350 ft
Osp	SWAN PEAK QUARTZITE (MIDDLE ORDOVICIAN)--Upper part mainly white, buff and pink to red, thick-bedded, cliff-forming fucoidal quartzite; lower part mainly black shale containing brachiopods and thin, buff, fucoidal quartzite interbeds. Shaly part drastically thinned or absent in places. Estimated thickness 200-400 ft
Ogc	GARDEN CITY FORMATION (MIDDLE AND LOWER ORDOVICIAN)--Mainly gray, thin-bedded slabby limestone. Upper part darker gray, thicker bedded, and contains abundant black chert nodules and stringers and a locally prominent and resistant, cherty dolomitic-limestone zone; characterized by intraformational breccia and conglomerate in lower two-thirds, and light-gray chert stringers at the base. Thickness 1,400-2,000 ft
€sc	ST. CHARLES FORMATION (UPPER CAMBRIAN)--Medium- to dark-gray, medium- to thick-bedded, medium-crystalline, cliff-forming dolomite and cherty dolomite; contains thin-bedded limestone and dolomite in upper part. Algal-mat texture common. Estimated thickness 800-1,600 ft
€sw	Worm Creek Quartzite Member--Buff, tan, light-gray, and yellow-brown; brown- or pink-weathering, thin- to medium-bedded, medium-grained, well-sorted, moderately well rounded, locally arkosic quartzite or quartzitic sandstone. Thickness 10-120 ft
€n	NOUNAN DOLOMITE (UPPER AND MIDDLE CAMBRIAN)--Mainly medium-gray, light- to medium-gray-weathering, thick- to massive-bedded, fine- to medium-crystalline, cliff-forming dolomite; contains minor sandy and silty dolomite and thin-bedded limestone interbeds. Calculated thickness 1,200-1,800 ft
€bo	BLOOMINGTON FORMATION (MIDDLE CAMBRIAN)--Interbedded olive to yellow-brown shaly siltstone and light- to medium-gray, thin- to medium-bedded limestone; shale interbeds and partings decrease northward. Calculated thickness 850-1,000 ft
€bl	BLACKSMITH DOLOMITE (MIDDLE CAMBRIAN)--Mainly medium-gray, light-gray-weathering, massive-bedded, medium-crystalline dolomite but grades laterally into light- and dark-gray-banded, thin-bedded limestone and dolomitic limestone in places. Contains one or more distinctively laminated, white, fine-grained dolomite interbeds in most places; oolites common. Calculated thickness 350-600 ft
€u	UTE LIMESTONE (MIDDLE CAMBRIAN)--Yellow-brown to olive shale having interbeds of gray, thin-bedded, silty, sandy, and oolitic limestone. Calculated thickness 400-600 ft
€l	LANGSTON DOLOMITE (MIDDLE CAMBRIAN)--Mainly gray, medium- to thick-bedded, medium-crystalline dolomite; typically has brown- or yellow-brown-weathering rind. Thin-bedded limestone member in upper part not mapped separately. Girvanella remains common. Calculated thickness 200-400 ft
€ul	UTE AND LANGSTON FORMATIONS, UNDIVIDED (MIDDLE CAMBRIAN)--Mapped only in Idaho part of roadless area where lower part of Langston contains high proportion of limestone and shale like that of Ute Formation. Calculated thickness 600-1,000 ft
€gc	GEERTSEN CANYON QUARTZITE (LOWER CAMBRIAN)--White, buff, and reddish-purple quartzite. Locally feldspathic; contains pebble- and cobble-conglomerate lenses. Exposed along west flank of Bear River Range. Estimated thickness 4,800 ft
€gcu	Upper member--White, pale-buff, or pink quartzite, locally has red or purple streaks. Generally coarse grained and poorly sorted. Small pebbles common and increase in abundance downward. Upper part locally contains buff, micaceous siltstone interbeds. Estimated thickness 3,500 ft
€gcl	Lower member--Upper part reddish-purple to white quartzite having abundant but decreasing downward lenses of cobble and coarse-pebble conglomerate; top marked by highest zone of cobble conglomerate. Lower part mainly white, buff, or greenish-gray arkosic quartzite having greenish grit lenses rich in altered, coarse feldspar grains. Best exposed on ridge north of High Creek. Estimated thickness 1,300-1,800 ft
€s	SILTITE (LOWER CAMBRIAN?)--Yellow-brown to olive, micaceous siltite and shaly siltstone. Estimated thickness 0-200 ft
Zhs	HEMATITIC SILTSTONE (LATE? PROTEROZOIC)--Red and purplish-red micaceous siltstone, quartzite, and pebbly quartzite; some layers rich in specularite, others crossbedded and arkosic. Possibly correlative with volcanic member of Browns Hole Formation (Crittenden, 1972). Best exposed on ridge north of High Creek. Estimated thickness 300-400 ft
Zq	QUARTZITE (LATE? PROTEROZOIC)--White, tan, and pink, medium- to coarse-grained, pebbly quartzite; crossbedded and locally feldspathic. Best exposed on ridge north of High Creek; minimum thickness 3,400 ft
€Zq	QUARTZITE (LOWER CAMBRIAN AND (OR) LATE? PROTEROZOIC)--White to tan quartzite of uncertain correlation; found only in isolated exposures along west edge of map area between Richmond and Smithfield. Thickness unknown

CONTACT--Dashed where approximately located; queried where uncertain

HIGH-ANGLE FAULT--Dashed where approximately located; dotted where concealed. Bar and ball on downthrown side. Arrows show direction of relative movement in cross sections

THRUST FAULT--Dotted where concealed; sawteeth on upper plate. May have had significant normal dip-slip movement after thrusting (shown by opposing arrows in cross sections). Arrows show direction(s) of relative movement in cross sections

MAJOR SYNCLINAL FOLD AXIS--Arrows show directions of dip and plunge

STRIKE AND DIP OF BEDS

40 Inclined

⊕ Horizontal

70 Overturned

APPROXIMATE BOUNDARY OF ROADLESS AREA

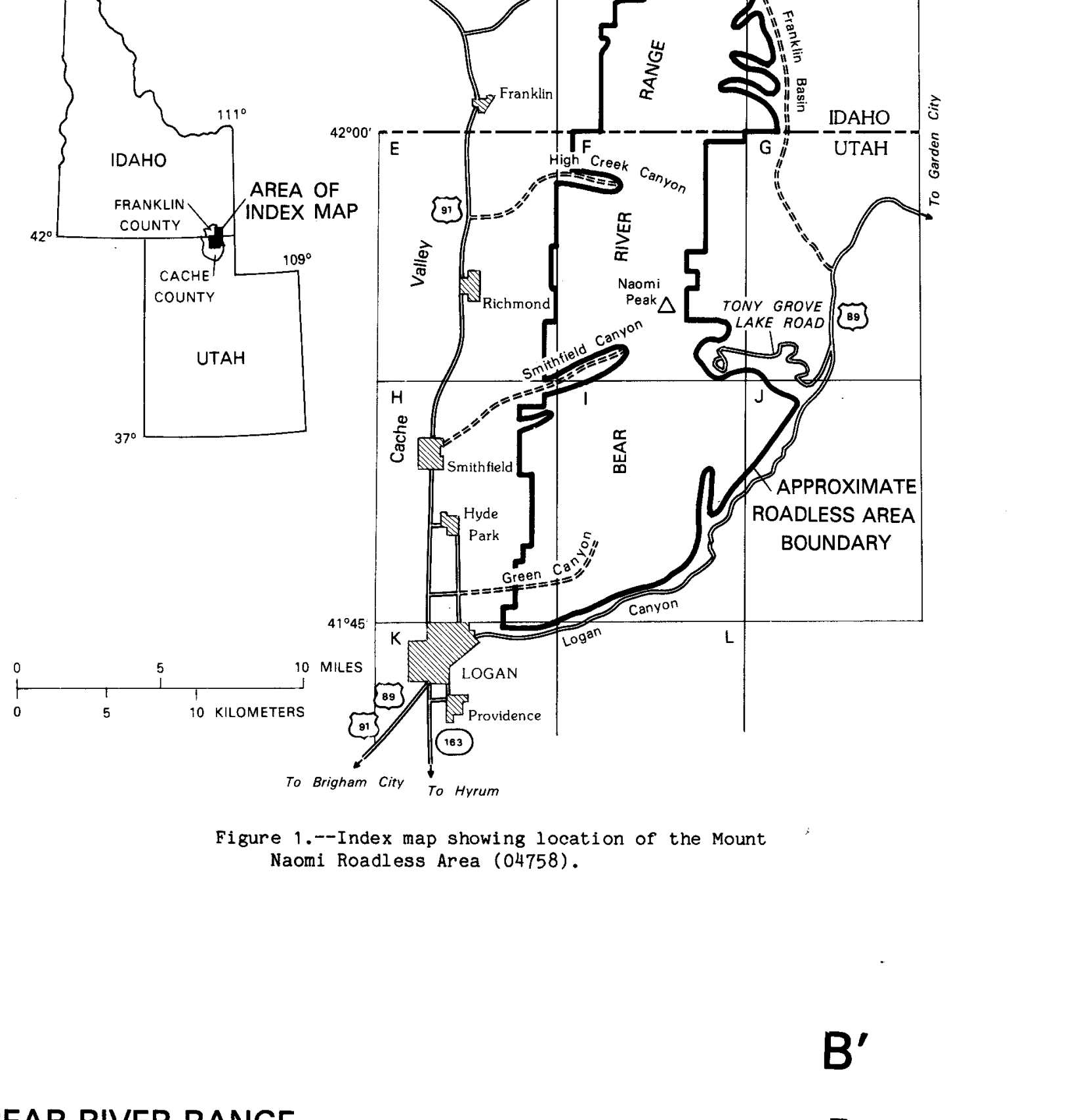


Figure 1.--Index map showing location of the Mount Naomi Roadless Area (04758).

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine the mineral values, if any, that may be present. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a geological survey of the Mount Naomi Roadless Area (04758), Cache County, Utah, and Franklin County, Idaho. Mount Naomi Roadless Area was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

INTRODUCTION

This geologic map was prepared as part of a mineral resource evaluation of the Mount Naomi Roadless Area ("Mount Naomi" is designated "Naomi Peak" on current U.S. Geological Survey topographic maps). Geologic data and interpretations are summarized in this report; related studies presented in companion reports include mineral resource potential (Dover and Bigsby, 1983), geophysics (Mabey, 1985), and geochemistry (Dover, McGimsey, and McHugh, 1985). A brief summary of the mineral resource potential of the Mount Naomi Roadless Area is also presented by Dover and Bigsby (1984).

Location, geographic setting, and access

The roadless area (see map and fig. 1) encompasses about 168 mi^2. It extends 28 mi along the crest of the Bear River Range, from near Logan, Cache County, Utah, to a point east of Preston, Franklin County, Idaho. Altitude of the range crest generally rises from about 9,000 ft in the Idaho part of the study area to nearly 10,000 ft in the Utah part. Cache Valley is west of the range. Maximum topographic relief is about 4,800 ft along the steep west face of the range in Utah, where altitudes range from 5,200 ft on the floors of several canyons to 9,979 ft on Mount Naomi, the highest point on the range crest. The crest and slopes were developed from flat or gently tilted bedding surfaces and are relatively smooth and gentle, but rugged box canyons throughout the roadless area have local relief of 2,000-3,000 ft. A few small glacial cirques are east of the range crest. U.S. Route 91, connecting Logan and Preston, is a few miles west of the roadless area; the roadless area is bounded on the south by U.S. 89 through Logan Canyon and on the north and northeast by graded gravel and dirt roads connecting Routes 89 and 91 via Cub Creek and Franklin Basin. Spur roads, providing limited access to the interior of the roadless area, are shown in figure 1; a network of well-maintained horse and foot trails provides good access to most parts of the area.

Present and previous studies

Geologic maps by Williams (1948) and Oriel and Platt (1968) show the Mount Naomi Roadless Area, but the area was largely remapped in moderate detail in 1979 and 1980 in order to (1) update stratigraphic subdivisions, (2) more accurately place contacts on improved topographic base maps, and (3) modify structural interpretations where necessary. However, in some places along the west edge of the map area, the mapping of Oriel and Platt and mapping by Galloway (1970) and Mendenhall (1975) is incorporated in the present compilation. The rocks of the Bear River Range have also been included in numerous detailed and regional stratigraphic studies.

STRATIGRAPHY

The Bear River Range contains a thick section of quartzitic and calcareous marine sediments that were deposited on a continental shelf developing along the western margin of the craton in late Precambrian through Paleozoic time. These rocks, representing at least 400 Ma of sediment accumulation, are more than 25,000 ft thick in the roadless area.

The lower part of the section, representing Late(?) Proterozoic and Early Cambrian time, consists mainly of quartzite and conglomeratic to arkosic quartzite and minor interbeds of micaceous or hematitic siltstone. These rocks previously were included in the Brigham Quartzite (see discussion in Oriel and Armstrong, 1971), but near High Creek, in the west-central part of the roadless area, they can be subdivided into units resembling those defined by Crittenden (1972) in the Huntsville area 35 mi to the south. More detailed work will probably show that Crittenden's Huntsville area stratigraphic nomenclature can be applied to the rocks in the lower part of the section throughout the roadless area.

Middle Cambrian and younger Paleozoic rocks are predominantly limestone and dolomite, but quartzite, sandstone, and siltstone interbeds and other zones of mixed lithologies form important marker horizons within the carbonate section. A great variety of carbonate types are represented, most of which are fossiliferous--some richly so. Ever since the days of the Territorial Surveys (Hayden, 1872; Hague and Emmons, 1877) and the classical work of Walcott (1908), Richardson (1913), and Mansfield (1927), the Bear River Range has served as an important reference section for the lower Paleozoic stratigraphy of this part of the Rocky Mountain region--mainly because the section is thick, continuous, well exposed, readily subdivided, and paleontologically well controlled. Interest in the Paleozoic section of the Bear River Range, including its middle and upper Paleozoic parts, remains strong because of its strategic location along the Wasatch hinge line, a long-lived zone of facies change between a thinner, shallower water cratonic-platform section to the east and a thicker, deeper water continental-shelf section to the west (Ross, 1951; Sando and others, 1959; Williams and Taylor, 1964; Sandberg and Poole, 1977; Sandberg and Gutschick, 1978). Devonian and Mississippian terminology used in this report follows the usage of Dutro and Sando (1963), Sando and others (1976), and Sandberg and Gutschick (1978).

Tertiary rocks overlap Paleozoic and older rocks along a major angular unconformity. Continental red-bed sediments of the Eocene Wasatch Formation are restricted to the southeastern part of the map area; generally light-colored tuffaceous sediments of the Pliocene and Miocene Salt Lake Formation crop out only along the west flank and north end of the Bear River Range and in Cache Valley. Tertiary rocks are preserved mainly in structural depressions adjacent to major range-margin faults.

Unconsolidated Quaternary deposits are thin and mantle Pleistocene ice channels and modern stream drainages.

STRUCTURE

The Bear River Range is a gently eastward-tilted fault block containing a broad fold named by Williams (1948)--the Logan Peak syncline. An inference required by regional relations, but not locally demonstrable, is that all of the pre-Tertiary rocks exposed in the range occur in a thrust sheet (or allochthon) that was transported eastward by a major, deeply buried thrust fault.

Thrusting

The major thrust surface on which the pre-Tertiary rocks of the Bear River Range were emplaced does not crop out locally but is exposed to the south, where it is known as the Willard thrust, and to the east. The allochthon floored by the Willard thrust apparently extends from near Ogden, Utah, to at least as far north as the Snake River Plain, and from Salt Lake Valley east to Bear Lake. Its thickness below the roadless area is uncertain because no drill hole or adequate seismic control is available; the sole thrust is shown diagrammatically at depths ranging from 20,000 to 30,000 ft in the cross sections. This depth is inferred from the exposed thicknesses of rock units within the Willard allochthon and assumes that the sole thrust is no more than a few thousand feet below the stratigraphically lowest (oldest) exposed rocks; the depth shown is probably a minimum. The configuration of the sole thrust parallel to bedding assumes that this segment of the sole thrust is a bedding-controlled decollement--an assumption supported by regional structural styles. South and east of Bear Lake (15-25 mi), the overridden rocks are folded Triassic and Jurassic sedimentary strata, but the age, lithologic character, and structure of lower-plate rocks concealed under the roadless area are unknown. Eastward movement of large magnitude is indicated for the Willard allochthon by the sense of associated structural overturning and degree of facies telescoping involved. Synorogenic conglomerates derived from the Willard allochthon and preserved east of the roadless area indicate a latest Jurassic to Late Cretaceous age for Willard and related thrusting.

Thrust faults of very small displacement are present in the southwest corner of the map area between Logan and Smithfield, Utah. These are probably minor imbrications below another large thrust, here called the Providence Canyon thrust, which is above the Willard and extends along the west flank of the Bear River Range and under Cache Valley. This thrust is exposed in the canyons south of Logan, where older beds are thrust over younger ones, and the overridden rocks are steeply dipping to overturned eastward. At the west edge of the roadless area, east of Richmond, Utah, intensely brecciated Upper Cambrian St. Charles and Ordovician Garden City Formations lie discordantly on Late(?) Proterozoic and Lower Cambrian quartzite. Similarly, small isolated masses of St. Charles Formation and Ordovician Swan Peak Quartzite discordantly overlie Middle Cambrian rocks at the west edge of the roadless area between Hyde Park and North Logan, Utah. All of these occurrences of younger rocks resting discordantly on older ones are regarded as remnants of a large landslide that extends at least 2.5 mi beyond the range front into Cache Valley. The slide is unconformably overlain by diamictite facies of the Salt Lake Formation, and the slide was probably caused by withdrawal of lateral support resulting from thrust-controlled normal faulting at the range front in pre-latest Salt Lake time.

West-directed thrust faults of small displacement are shown diagrammatically in the cross sections to splay upward from the Willard thrust. These are inferred to be distributed in a zone of local compression under the west flank of the Bear River Range; the zone of compression could have formed as a consequence of regional tilting of the range in response to rotational normal faulting on the east (see cross sections). West-directed thrusts were not observed during the present study, but some surface examples with appropriate character and orientation were mapped by Mendenhall (1975) east of Richmond.

Folding

The axis of the Logan Peak syncline plunges gently S. 15° W.; the axis parallels the crest of the Bear River Range from Logan Canyon north to Naomi Peak and from there projects a little east of the crest towards Franklin Basin. The syncline is at least 10 mi across and asymmetrical to the east. Bedding is moderate to steeply dipping or steeply overturned on the west limb, but dips rarely exceed 20° on the east limb. The youngest Paleozoic rocks (Mississippian) in the map area are preserved in the core of Logan Peak syncline, and the oldest rocks (Late(?) Proterozoic) crop out on its west limb. The syncline probably terminates in the subsurface at the Willard thrust, just as comparable folds exposed elsewhere at the leading edge of the Willard allochthon are truncated. Main folding of the Logan Peak syncline is related to Willard thrusting, but at least some of the asymmetry and overturning of the west limb is attributed to drag beneath the overriding Providence Canyon thrust (Williams, 1948).

A broad anticline of low amplitude (axis not shown on map) is adjacent to the Logan Peak syncline on the east, along upper Logan River; the anticline contains Middle Cambrian rocks in its core. Another large syncline, having a Devonian core, is in the northeast corner of the map; its axis is mainly outside the study area and is not shown on the map. Both of these folds, as well as parts of the Logan Peak syncline, are complicated by moderate displacements on high-angle faults.

Normal faulting

High-angle normal faults having moderate to large displacements are exposed or can be inferred in two main zones flanking the Bear River Range--one along the range front on the west, and the other east of Logan Peak syncline. Though steep at the surface, these faults are thought to flatten with depth and merge with major, pre-existing thrust surfaces in the subsurface (see cross sections). For the most part, the normal fault zones are just outside the roadless area, but they fundamentally control the structure of the Bear River Range within the roadless area.

A complex history of recurrent or intermittent movement, at least since the time of Salt Lake Formation deposition, is indicated for the range-front fault zone. The diamictite facies of the Salt Lake requires a steep, presumably fault-maintained source area adjacent on the east. Contact relations between the Salt Lake Formation and pre-Tertiary rocks of the Bear River Range are poorly exposed and difficult to document, but relations seem to vary along different segments of the range front. In a segment of the range front extending from Hyde Park, Utah, to within 5 mi of the Idaho State line, the Salt Lake diamictite seems to lap unconformably at a low to moderate angle onto the flank of the range and seems to have been relatively little disturbed since deposition; in this area, faults of the range-front zone having minor displacements splay into the pre-Tertiary rocks of the range but do not appear to cut the Salt Lake, though they may account for gentle dip reversals within the diamictite unit. Moreover, east of Richmond the Salt Lake depositionally overlaps a large landslide mass that most likely formed as a result of earlier or concurrent normal faulting at the range front. In contrast, along the Idaho segment of the range front, the steepness of the Salt Lake-pre-Tertiary contact and the relatively gentle attitude of the Salt Lake suggest that the contact is a fault having continued or renewed movement after Salt Lake deposition. Post-Salt Lake displacement on a range-front fault is also inferred under Bonneville deposits in the segment of the range front south of Hyde Park. The range-front faults in the northern and southern segments of the zone bend westward into Cache Valley, away from the range front, and may intersect or merge west of Richmond, Utah. Most faults of the range-front zone are overlapped unconformably by, and all pre-date, Bonneville Formation and other Quaternary sediments. The range front was steep and presumably represented a fault-line scarp at the time of Bonneville deposition as it did in Tertiary time and still does today, but no evidence of Quaternary fault displacements were observed at or near the range front in the vicinity of the roadless area. Subsurface positions of buried faults are based on abrupt topographic breaks in slope, distribution and structure of Tertiary rocks, and geophysical evidence (Mabey, 1985). Cumulative movement on the range-front fault zone is probably at least several thousand feet, but stratigraphic control on the amount of displacement is lacking. South of Hyde Park, the inferred range-front normal fault nearly coincides with and is most likely controlled by the steep, near-surface part of the Providence Canyon thrust; normal movement either utilized the pre-existing thrust surface itself or was on a newly formed break, listric to the original thrust. The extent of earlier thrust control on the range-front fault zone north of Hyde Park is not clear.

The fault zone east of Logan Peak syncline consists of numerous interconnected strands and cross faults. Stepped normal faults, most having down-to-the-west movement, characterize the southern part of the zone (section A-A'); a central horst with flanking graben and half-grabens occur in the central part (section B-B'). To the north, northwest-trending fault splays bound horsts and grabens 1-3 mi across, and the fault zone as a whole curves northwestward to intersect the range-front fault zone at the north end of the roadless area. The listric style of the faults shown at depth in the cross sections is based on sections closely controlled by seismic and well data in adjacent parts of the Cordilleran thrust belt (Royse and others, 1975; Lamb, 1980; Rubey and others, 1980). Moreover, the position of the listric zone with respect to major folds within the Willard allochthon suggests a step in the sole thrust to a higher stratigraphic horizon within the lower plate below the zone of faulting. Displacements indicated by offset Wasatch and Paleozoic contacts range from a few hundred feet or less to as much as 4,000 ft of dip-slip component on individual faults; cumulative movement represented by the entire zone may be as much as 5,000 ft in the southern part and 6,000-7,000 ft in the central part. Wasatch beds are tilted 5°-15° eastward in individually rotated listric fault blocks within and adjacent to the fault zone, and eastward tilting of the range as a whole may be comparable.

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GEOLOGIC MAP OF THE MOUNT NAOMI ROADLESS AREA, CACHE COUNTY, UTAH, AND FRANKLIN COUNTY, IDAHO

By

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1987

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1987

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